

# Differentiated Learning

(stretching the most able)



A report of a forum for invited participants sponsored by the Centre for Bioscience, Higher Education Academy

Weetwood Hall, University of Leeds  
12 - 13 June 2007



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## 1. Executive summary

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This report contains a summary of the main points emerging from a forum, arranged by the Centre for Bioscience, Higher Education Academy, to discuss the topic of “Differentiated Learning – stretching the most able students”.

The forum was held at Weetwood Hall, University of Leeds, 12 -13 June, 2007 and focused on the biosciences. Twenty invited participants attended.

The forum agreed that higher education should develop each student to their full potential and noted that special provisions were almost always made available to weaker students who were struggling with their courses. However, special provision was not common for the most able students even though these students, if fully developed, might make a disproportionate contribution to innovation and discovery in their disciplines and the development of the UK economy.

The forum therefore agreed a working objective: *to discuss the issues, problems and possibilities around the provision of different learning opportunities with the intention of achieving different learning outcomes in the most able students.*

The forum discussed extensively a number of issues including:

- Why is differentiated learning a current issue?
- Is differentiated learning ethical?
- Is differentiated learning desirable and a practical possibility for students, staff and institutions?
- What is the nature of the provision which will appropriately stretch the most able?
- How do we cope with students who are exceptional in only one aspect of their work, are later developers or fail to live up to early promise?
- What aspect(s) of skills, knowledge and attitudes should be involved?
- What resource will be needed and where will it come from?
- How many students might be involved on a national or local basis and how could this affect any provision?
- How is provision organised and by what provider(s)?
- How are selection, assessment and accreditation carried out?
- What existing provision is currently available to stretch the most able bioscience students?

Within these areas the forum identified a large number of issues and factors which impinge on differentiated learning and which must be taken into account in any initiative to stretch the most able students.

It was not the intention of the forum to make recommendations, but a number of ways were identified in which the Centre for Bioscience might progress this area in order to assist bioscience units in those HE institutions that might wish to provide more stretch for the most able students locally or nationally.

## 2. Introduction

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The issue of differentiated learning has recently come to the fore. In part this is because of:

1. the wider range of ability of those participating in higher education (HE) compared to 10 years ago;
2. the growing emphasis within the UK education system as a whole on developing all learners to their full potential;
3. a realisation that the most able students are not being stretched to achieve their full potential;
4. an appreciation of the need to stretch the most able students because of their contribution to advancement and innovation in specific disciplines and consequential benefit to the UK economy.

As differentiated learning has only recently come to prominence, there is no road map defining how it can be achieved, and little experience in carrying it out within an HE institution. In order to improve our understanding of this issue the Centre for Bioscience convened a forum of invited participants with interests, views or expertise in this area. This report summarises the major points made during the forum. It was not intended that the forum provide ready made answers, but that it expose and discuss the issues involved to enable bioscience units and institutions to see more clearly how to take this matter forward in the coming years.

## 3. What is differentiated learning?

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There was no intention to produce a 'set in stone' definition of differentiated learning, but it was felt useful for the forum to adopt a working definition for the purposes of the meeting. Independent discussion in three groups produced statements that differentiated learning is:

- *“Enabling and stimulating each student to realise his / her full (intellectual and practical) potential”;*
- *“Empowering students of all abilities to reach their maximum potential through tailored learning opportunities”;*
- *“Recognising the diversity of the academic / intellectual backgrounds of the student population to encourage all students to achieve their full potential”.*

It was appreciated that differentiated learning therefore included remedial help for the least able: *“it’s already happening for weaker students, but all students deserve equal access (to differentiated learning) and this could provide potentially greater reward for institutions and society”.*

The general perception was that the brightest students are not stretched to their full potential, therefore, the forum mainly focused on this aspect. The objective of the forum therefore became:

**“to examine the issues, problems and possibilities around the provision of different learning opportunities with the intention of achieving different learning outcomes in the most able students.”**

A number of points and counterpoints were made during discussion:

- a) Do we mean differentiated learning or differentiated teaching? Probably the former since learning can be achieved by suitable provision without the need for formal teaching as such. It is likely however that students will still need direction towards differentiated learning objectives;
- b) Do we already provide this with graded degrees? Some students obtain firsts, some thirds. While this is true, it is not the intention that some students should necessarily obtain lower grades than others, and selection for the opportunity to obtain a high or low grade degree does not occur. This is not therefore differentiated learning within our definition;
- c) Are universities graded and do they therefore already provide differentiated learning? Universities have different entry standards (i.e. they require different qualifications or grades) and degrees from different institutions may be seen, rightly or wrongly, to be of different value, particularly by employers. In one sense therefore graded universities do provide differentiated learning if the student population is regarded as a whole. Within each university however provision of learning opportunities is even and not usually dependent on ability;
- d) Do we differentiate learning objectives by type, by content or by level? Clearly, any form of differentiation is possible and the nature of the differentiated objective will have implications for how provision can best be achieved;
- e) Although not discussed extensively at the forum there is an issue with regard to the term 'most able'. It may be that a student is 'most able' in all aspects of the knowledge, skills and attitudes required. Possibly more often however, a student may have exceptional ability to 'become a leading researcher', or to 'become a gifted and inspirational teacher', or to be excellent at communicating science to the public, or to be excellent at *some aspect* of their work. The extent to which excellence is demonstrated over a wide field or much more narrowly in an aspect of the field of study/work should be considered in terms of how this is recognised, stretched and accredited;
- f) Are we talking about differentiated learning taking place within a degree programme, within the student learning experience, or within the student experience as a whole? Again, all three options seem possible and there are different implications for selection, for assessment and for accreditation depending on which is chosen;
- g) How do schools handle very bright and gifted pupils? Note: National Academy for Gifted and Talented Youth ([www.nagty.ac.uk](http://www.nagty.ac.uk)), Gifted and Talented from the DfES ([www.standards.dfes.gov.uk/giftedandtalented/](http://www.standards.dfes.gov.uk/giftedandtalented/)) and Gifted and Talented from the QCA ([www.nc.uk.net/gt/index.htm](http://www.nc.uk.net/gt/index.htm));
- h) Exceptional talent in sport is carefully nurtured and developed (e.g. UK Olympics Training Squad; Sports Science scholarships and bursaries, Talent scouts, Yorkshire Cricket coaching). Why does a similar philosophy not operate for exceptionally talented scientists?
- i) Are there role models of exceptional bioscientists to whom students can aspire/relate?

#### 4. Why is differentiated learning a current issue?

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In spite of their reputation as ivory towers, universities have not remained unchanged by the passage of time or by changes in society and government policy. One such change has involved increasing participation. In recent years in the UK the percentage of the 18 to 30 age group participating in university education has grown from about 3% (1962) to about 45% (2004), and is set to increase further

to the government target of 50%. This increase in participation has been accompanied by an increase in the range of student ability, aspirations and motivation. Since there is a tendency to direct teaching at the middle of the ability range, there is evidence that there are problems at the extremes. This can be illustrated by a quote from a student who said *'you know there are 3 groups in the class – those who are bored, those who are OK and those who are lost'* (2<sup>nd</sup> year pharmacology student).

For those who 'are lost', or to put it in today's speak 'those who are challenged by the pace or level of the provision', universities have in place a variety of mechanisms to provide support. These include remedial classes, provision of supplementary material for self-directed learning, tutorial support, counselling and a variety of other mechanisms to help those who are struggling. While these provisions are costly, universities have targets for retention of students and a student leaving is a fee lost. There are therefore strong financial imperatives to help struggling students to achieve their full potential.

At the opposite end of the range however, the very bright student can probably cope easily, is unlikely to be thrown out or to leave, presents no financial risk, and on this basis usually attracts no additional provision. However, the very bright student may be at least as far above the norm as the struggling student is below it and should have equal entitlement to be developed to his or her full potential. Indeed, many universities include in their mission statements that they aspire to develop each student to his or her full potential. In addition, the very bright students may contribute to the advances and innovations in science and knowledge on which the future prosperity of "UK plc" is based. They are therefore the lifeblood of our disciplines and the economy.

The increased range of ability of university students has therefore highlighted the special needs of both the less able (provision for whom has been made in many cases) and the more able (where provision is often lacking). Some students may not want to be stretched and may prefer to cruise through their degrees. However, it could also be argued that very able students, given the resources already available in universities, will stretch themselves to their maximum potentials anyway, and that no extra resource is needed. Opportunities for stretching able students are more likely to be present when problem-based learning and other student-centred methods are used extensively in the teaching provided. While some students may be able to stretch themselves, others may need external challenges to reach their full potential. Other factors pushing this issue to the fore are:

- **Attraction:** increased student choice in level of provision may attract students and meet different customer demands. 'We deliver to each according to their needs.....' is a powerful marketing tool;
- **Competition:** With demographic trends indicating a sharp fall in the numbers of people in the university age group (Bekhradnia, 2006) competition between universities to fill allocated places is set to become more intense. Each university wants the best students since they are less trouble, more interesting, stretch teachers and are more likely to continue to postgraduate research degrees. Stretching the most able is also a very good selling point in the growing overseas market where students are often highly able and motivated and can make choices as to where they spend their money;
- **Expectation:** The new arrangements in schools will encourage the identification of the most able and provide for their special treatment. The National Gifted and Talented Scheme (Department for Education and Skills, 2005) aims to identify able students at school, the top 5% of students are invited to join NAGTY (National Association for Gifted and Talented Youth), enabling them to benefit from a wide range of activities, including residential summer schools. Pupils may take exams (GCSEs, AS levels and

A levels) early and the proposed extended project within the new A levels (QCA, 2006) also aims to stretch the more able pupils in school. Will not such pupils then expect similar arrangements when they move to university?

## 5. What additional/different learning are we looking for?

Clearly, the additional material could come from a variety of areas. What extra material would best stretch able students?

- Specific subject knowledge?
- Broader knowledge (cross discipline)?
- Generic skills?
- Problem solving?
- Application of knowledge?
- Data interpretation?
- Creative thinking?
- Critical thinking?
- Enterprise and entrepreneurship?
- Team working?

Is this dependent on the individual student?

## 6. How is differentiated learning accessed?

Differentiated learning could be achieved by all the students doing the same basic course but having open ended tasks assessed with progressive learning objectives where students could opt to achieve the level of learning which is appropriate for them. While this is possible, it would be difficult to set such tasks and to assess them. It was generally considered this idea was best put in the 'too difficult' box. The alternative is for there to be different provision or opportunities for the students. They could then undertake differentiated learning:

- On an ability to pay. If this was allowed it would seem to destroy the whole idea of differentiated learning for the most able;
- On a voluntary basis (opt in);
- On a compulsory basis ("we decide if you'll follow a different path");
- On a competitive basis where access is by competition with peers. Competitive judgements could be made on the basis of current performance, potential ability or motivation or other discriminators. Judgements could be against an absolute standard or relative to peers, on past performance, on future intention, or on performance in a given task.

## 7. How is differentiated learning assessed and accredited?

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Again several points and counter points were identified:

- Does the differentiated learning have to be assessed or accredited at all? After all the learning is still the same – or is it?
- If assessed, would this be within the existing degree classifications? Would 'starred degrees' be a possible route?
- Would a different degree title be necessary? For example – Further Biochemistry or Biochemistry Plus, or perhaps counter productively, Biochemistry for Boffins.
- Would separate certification, mark transcripts or an entry in the Record of Achievement be appropriate?

Assessment raises several peripheral issues. Clearly there may be more time required which increases workload. Assessment could be separate from the normal degree assessment or part of it. In the latter case this would involve setting and marking assessments which would allow a great range of achievement to be demonstrated. This is probably very difficult to do. In addition, academics would have to be prepared to give marks approaching 100% if the marks of normally achieving students are not to be depressed.

## 8. How is differentiated learning delivered?

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Delivery could be within the university (internal) or outside the university (external). A number of possibilities were identified:

### **Internal:**

- Sets and streaming? Starred degrees?
- Voluntary extra classes/material (essays, tasks, involvement in research, separately certificated master-class...) Implications for assessment?
- MSc? Does this allow those who wish to differentiate to do so or, since the MSc comes after completion of the BSc, does the timing mean that this is too late?
- Fast track – BSc and MSc together in 3 years? Or Year 3 modules taken in Year 2?
- Open ended tasks with graded assessment and learning outcomes: very difficult to arrange;
- Self-driven, self-motivated – nothing extra but free up time by, for example, providing a grant to remove the need for employment during the degree, or a paid position within a research lab during vacations?

### **External:**

- Master classes from outside bodies (e.g. professional/learned societies);
- Essay competitions run by outside bodies;
- External grants – e.g. to attend research conferences or reduce the need to work so that additional study can be undertaken;
- External placements in work/research;

- Student membership of Learned Societies forms a differentiated learning experience outside of the student learning experience, although this is self selection rather than selection by learning or grades.

Each of these would have resource implications for the university (if internal), for the outside body (if external) and possibly in either case, for the student.

## 9. Barriers to differentiated learning

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Participants identified several major potential barriers to implementation of differentiated learning:

- If differentiated learning was to be applied in every year, then this could potentially affect the number of students, if some students not selected for the higher route then decided to leave;
- Availability of staff time and resources generally;
- Academic attitudes (e.g. the belief that time spent in a research laboratory over the summer would confer an unfair advantage and should only be offered if ALL students could participate);
- Fair identification of students regarded as the most able;
- Administrative systems which do not easily permit students to take paths quantitatively different from the norm (e.g. take 8 x 20 credit modules rather than the standard 6);
- Perception of students as being “left out” if they are seen to be very different from the average. The need to provide emotional support for exceptionally able students should not be underestimated. Some students may be academically very able but socially and emotionally less so;
- The need for flexibility so that arrangements can cope with students who develop late or do not show sustained excellence;
- Rewarding students for extra work on top of their degrees; they may ask “what’s in it for me if I do this extra work?”.

## 10. Is differentiated learning ethical, fair and achievable?

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This issue was addressed at various points during the forum and a number of points and counterpoints were made as below. The presentation and argument led by Rob Lawlor and Georgia Testa is also presented in the form of a summary of their presentation.

General points made during the forum:

- Within institutions, home students all pay the same – should they all receive the same teaching and support?
- Selection for university has become politically contentious and selection to participate in, for example, a master-class could be more so. Who decides and on what criteria? Is there a level playing field?
- What about peer pressure, especially in the first year where students are constrained to do no more than their friends? Note - the really able student has probably already got used to overcoming this since they have been living with it from an early age;

- d) What about student attitudes? – For example, to do the minimum work required? Again, the really able student may well be the one who does not have this attitude;
- e) Will universities (as a business) ever look at the educational need (stretching bright students) rather than the financial imperative (payment for retention of less able students and position in league tables)? Is a change in the funding model needed if bright students are to be stretched?
- f) Early and late developers – is there a way back if a student changes their mind? What about late access to ‘stretching’ courses for those who only flower in year 3? Flexibility of interchange between stretching and less stretching programmes must be available, but will this flexibility destroy the whole concept, and would this be feasible and practical?
- g) Are we dealing with the top 5%, 0.5% or 0.05% of students, (translated to numbers of Bioscience students in the UK, this is 7500, 750 and 8), or just with the Ruth Lawrences (who went to Oxford aged 12, graduated aged 13 and had a professorial post at 19)? They will not necessarily be evenly distributed between universities. The numbers involved will in part determine whether this is a local or national provision. There may be benefit in directing extra stretch at say upper second class students to see if they can be developed into first class graduates;
- h) Can students balance social life, debt, employment, maturation, standard academic work AND excellence?
- i) Are students sufficiently interested in the long term perspective at all?

### 10.1 The Ethics of differentiated learning (presentation summary)

Rob Lawlor and Georgia Testa, IDEA CETL; r.s.lawlor@leeds.ac.uk, g.testa@leeds.ac.uk

#### Part One

Some might think that differentiated learning is inconsistent with the principle of “same fees, same resources”, and for this reason is impermissible. We argue that the “same fees, same resources” principle does not rule out differential learning, but only imposes limits on it.

#### Part two – a debate

- Against “same fees, same resources”:

Rob argued that there were two reasons why we should reject “same fees, same resources”.

First, although students do pay fees, higher education is still subsidised, and this is not solely for the benefit of students, but for the benefit of society and the economy. This justifies giving more to the better students.

Second, students don’t want the same amount of attention. The stronger student wants to be pushed, and the weaker student wants help, but the average student is happy to cruise along and may even resent any more attention.

- For “same fees, same resources”:

Georgia argued students are paying for a service, and therefore can expect to have the same amount of resources dedicated to them. It might be appropriate to give different types of resources to different students (as they have different needs) but they should receive the same *amount* of resources.

Georgia used the analogy of a fitness instructor who might offer different types of exercises for different individuals, but someone could legitimately complain if someone else, who had paid no more, received more time and attention.

- Agreement:

But we both agreed that the strength of the argument for “same fees, same resources” is proportional to the cost that is paid by the student themselves, rather than being subsidised by the government.

### Part three

Finally, we argued that, if differentiated learning was implemented, in the form of streaming, it was important to ensure that the system was flexible enough to allow students to subsequently move up or down streams in response to any change in their learning requirements or abilities.

## 11. Examples of differentiated learning in bioscience

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### 11.1 Open-ended practical work with multiple learning objectives

*Ian Hughes; i.e.hughes@leeds.ac.uk*

This example comes from the late 1980s when learning objectives were usually poorly defined but, in essence, the 2<sup>nd</sup> year students carried out a laboratory class over 6 hours in which they determined the potency ratio of two drugs on a piece of ileum muscle isolated from a guinea-pig. The basic schedule required them to determine the potency ratio using a simple design by obtaining data for two dose-response curves (one for each drug) and then processing and writing up the data in the form of a laboratory report. They were also required to provide the answers with explanations to 3 questions (Would the potency ratio be the same if determined on i) another piece of guinea-pig ileum muscle; ii) a piece of elephant ileum; iii) a piece of diaphragm muscle?). The students were assessed on the quality of the data, the write-up provided and the answers to the 3 questions.

The lab work was open ended in that the schedule gave the students the option of designing the experiment differently themselves so as to provide an estimate of potency ratio WITH a confidence limit. Additional optional questions were provided at 3 grades to stretch the more able. Grade 1 asked the students to explain how potency ratios determined on isolated tissues related to potency ratios in the clinical situation. Grade 2 asked students to explain what measures should be taken to allow meaningful comparisons of potency ratios between sympathomimetic amines in isolated tissues for the purposes of receptor classification. Grade 3 asked for an explanation as to whether receptor classifications based on agonist or antagonist potency ratios were more likely to be valid.

Over 2 years and 105 students, 91 chose to attempt only the basic practical schedule. Four attempted the extended practical task, 14 attempted the Grade 1 supplementary question; 2 the Grade 2 supplement, and nobody attempted Grade 3.

On being asked why they had not attempted the additional work, 51 of the 91 students, felt they were not exceptional students and it was not designed for them (depressed aspirations?), 47 said they did not know how to answer the questions or what was expected, 39 said they did not have the time/interest and 31 said they did not do the additional work because no additional marks were available.

This activity was interesting to try and brought out a number of issues to think about, but the exercise was not felt to be successful and was abandoned after 2 years.

## **11.2 Laboratory-based final year projects only available to students performing well in years 1 & 2**

*Ian Hughes; i.e.hughes@leeds.ac.uk*

This activity provides differentiated learning by permitting only those students who perform well in previous years to choose to do a laboratory-based final year project. Other options are provided for the less able or those with other interests (library-based literature reviews; surveys of e.g. medicine use on wards, development of computer-based learning aids, development and delivery of lessons on drug misuse to 14-18 year olds).

In part this strategy was devised to limit the number of laboratory-based projects which had to be offered, but it does also provide differentiated learning. Some students resent it but generally the feedback is that students appreciate the choice of types of project available. Not everybody would agree this approach is fair or desirable. In some institutions “weaker” students are counselled to take a library-based dissertation option rather than a laboratory-based project.

## **11.3 Drug development master-class**

*Ian Hughes; i.e.hughes@leeds.ac.uk*

In the period between the end of first semester exams and the start of the second semester this additional 2 day master-class was offered to students. The class was taken up by about 50% of the students, who practised generic skills and were provided information on market assessment, finance, profit and decision making in the context of the discovery and development of new drugs. It was run in small groups (of 6-8 students) and was designed to achieve a variety of objectives:

- a) To gain an appreciation of the time scales and activities involved in the process of discovering, testing, obtaining approval for, and marketing, a new prescription medicine;
- b) To understand the mix of factors influencing the market and how the choice of a discrete area in which to invest research effort is made;
- c) To experience the use of a rating system for market investigation and to select a disease area in which to undertake drug development activities;
- d) To understand the financial issues behind a potential research programme and the concept of income, expenditure, profit, expenses and the balance sheet;
- e) To appreciate the pros and cons of rational design vs. high throughput screening or other strategies in the drug discovery process;
- f) To use data generated from biological tests to appreciate the hurdles which need to be overcome to produce a compound which could progress from the research laboratory into studies in volunteers;

To use the information presented to practice and develop skills in analysis, negotiation, data interpretation and decision making;

To practise and develop communication skills and the ability to work in a team.

Students were given a certificate to accredit the fact that they had attended all parts of the 2 day class. The student feedback was excellent. Note that assessment was by attendance, not performance, and that a high proportion of students participated with clear evidence of widely different abilities in the groups.

#### **11.4 Problem-based learning and student selected components in medicine**

*Michael Hollingsworth; mike.hollingsworth@manchester.ac.uk*

From semester 1 year 1 medical students at the University of Manchester use problem-based learning as the centre of the course (Manchester University School of Medicine, 2007). They work in groups of 12 students studying a weekly written problem, e.g. a case of asthma. In session one they identify the learning objectives before studying individually using a wide variety of resources. In sessions 2 and 3 they discuss their understanding of the topics. The learning objectives, although focussed on the case, are open-ended and so encourage students to explore depth and breadth.

In year 1 all students do an individual literature review, which develops many skills, such as finding and evaluating information, as well as writing skills. A critical analysis of the literature is expected so challenging the most able. In year 2 students undertake a group poster over a semester, so developing many team skills. They have to integrate knowledge from basic science, clinical experience and behavioural science. Assessment is based on the content and presentation of the poster, as well as the ability of students to answer questions by examiners. Able students are challenged both in terms of the open-ended nature of the task and their abilities to mould the group.

#### **11.5 Differentiated learning programme management**

*Neil Morris; n.p.morris@leeds.ac.uk*

As a degree programme manager for around 100 students I offer differentiated support for my students according to their academic performance. In addition to the personal tutorial system I offer all students the opportunity to meet with me after each set of examinations to discuss their examination results, revision techniques, aspirations etc. Additional resources are offered to very able students (e.g. reference to textbooks likely to stretch them, seminal research papers etc). In addition, all students receive a personal letter at the end of each academic session summarising their performance and offering advice on how to improve their academic grades – in fact, these letters come from 3 templates (weak performance, average performance and exceptional performance) and offer advice appropriate to their grade profile. These letters are sent along with the reading list for the forthcoming academic session. In this way, I feel all students are offered individualised and differentiated advice according to their performance / skills.

#### **11.6 The Gatsby Plants Summer School**

*Aurora Levesley; a.levesley@leeds.ac.uk*

Student perception of plant science is often negative, so much so that despite having significant freedom to choose study options, the avoidance of plant biology has started to be a problem. There are so few students taking plant-based options that many plant biology degree programmes have closed and attracting students with a solid knowledge of plants into plant based PhDs is proving challenging.

The Gatsby Charitable Foundation, recognising this problem, has funded Gatsby Plants, which aims to change student attitudes to plants, largely through an annual summer school for up to 100 high achieving end of first year undergraduates. Students are exposed to cutting edge plant science research in a conference style format and to investigative and engaging practicals. They also have the unique opportunity to interact with lecturers and plant scientists from the UK who are also present throughout the summer school week. In essence, high achieving students see how science works and are challenged to new ways of thinking about plants.

Although the summer school aims to change student perceptions of plant science, the approach taken has wider implications to issues surrounding differentiated learning. Key to the approach is the support from an established network of UK plant scientists, without whom the summer school would not be possible. The network ensures that students have the opportunity to talk to and discuss plant science with a range of academic tutors during the summer school, as well as providing support in terms of developing engaging practicals and in selecting students. High achieving students are selected from 20 UK universities from a range of biologically-based degree programmes, each university deciding on its selection criteria.

Also core to the approach is the link between research and teaching. Students are introduced directly to the world of research plant science through plenary talks by world-class national and international speakers. This year's talks included 'Preventing AIDS and Infectious Disease with Plant-made Vaccines' Prof Charles Arntzen, Arizona State University; 'Small Silencing RNA - the Dark Matter of Genetics' Prof David Baulcombe, The Sainsbury Laboratory, John Innes Centre; 'A Fork Full of Medicine: Anticancer Activity in Broccoli', Prof Richard Mithen, Institute of Food Research, Norwich; 'Plants in our Lives: from Beauty to Death', Prof. Monique Simmonds, Royal Botanic Gardens, Kew. All morning talks are followed by a tutorial, led by an academic, which is followed by a question and answer session where the speaker is asked remarkably challenging and perceptive student questions.

Three years into this 4 year project and we have some encouraging results to suggest that the summer school has indeed changed student attitudes to plants.

- 95-98% (for 2005 and 2006 students respectively) agree that their perception of plants is more positive as a result of the summer school.
- 51-76% agree that their career aspirations have been influenced by the summer school.
- 24% students (2005 students) are applying for plant based MSc/PhD and 58% of students for other science-related post graduate qualifications.

Interestingly we also have evidence to suggest that the summer school has had additional value, for instance, 91-94% agree that they have benefited from skills obtained at the summer school and 83-93% agree that the summer school encouraged them to stay in science or research.

More about the Gatsby Plants Summer School and its sister project, development of a teaching resource to assist lecturers in enthusing students about plants, can be found at: [www.gatsbyplants.leeds.ac.uk](http://www.gatsbyplants.leeds.ac.uk)

### **11.7 Summer vacation studentships**

*Jim Deuchars; [j.deuchars@leeds.ac.uk](mailto:j.deuchars@leeds.ac.uk)*

Summer vacation studentships are funded by research funding bodies such as the Wellcome Trust, BBSRC and Nuffield Foundation, as well as learned societies like the Physiological or Biochemical Societies. The students are paid from £150 to £200 per week for a period of up to 10 weeks to conduct research in a laboratory. The purpose is to give promising undergraduates an opportunity to experience first hand a period of time in a research laboratory and to encourage students to consider a career in scientific research.

Students are stretched through:

- 1) answering real research questions to which the answers may not be known;
- 2) acquiring physical skills to levels previously not attained;
- 3) independent working;

- 4) time management;
- 5) working hours – getting out of bed on time!

This benefits the students as they get paid, have a chance to sample lab research, an addition to their CV, possibly publications and contacts with other lab members. The lab benefits from a pair of hands, future PhD students, environmental enrichment and promotion of science.

## 12. Differentiated learning scenarios (outcomes of group work)

These scenarios were presented to delegates at the forum. Delegates were divided into two groups: both worked on scenario 1, each group then worked on either scenario 2 or 3. Suggestions from the group are presented after the questions.

### **12.1 Scenario 1: An exceptional student**

You are aware that one of the students (Julie) entered year 1 of the bioscience degree programme, for which you are co-ordinator, with 6 A grade A levels. Her tutor has reported that in tutorials during the year she has been rather quiet but has always performed well and responded correctly to direct questions. At the end of year 1 you observe that Julie has obtained marks of 79%, 85%, 90%, 78%, 83%, 84% in the 6 (20 credit) modules she has taken as part of the degree programme.

#### **12.1a. Dealing with an exceptional student**

What advice would you give to the tutor on how to approach this student and the issues he should discuss with her?

- a) Does Julie appreciate she is gifted? Was this identified at school? How does she feel about it?
- b) What are Julie's ambitions? Science? City? Or does she not yet know?
- c) Confidence building and re-assurance may be important;
- d) Make her aware of the options available in the university;
- e) How to maintain an "upward trajectory" from such high initial achievement;
- f) Maintain a regular ongoing conversation – not a one-off interview;
- g) Alert other academic staff;
- h) Discuss possible problems with her e.g. social exclusion, peer pressure to conform, balance of university activities.

#### **12.1b. Opportunities for exceptional students**

What arrangements already exist within your university through which the tutor could ensure that Julie was stretched in year 2 and developed to her full potential?

- a) Summer reading list sent to Julie with letter of congratulations;
- b) Provide opportunity for attendance at research seminar(s);
- c) Summer placement (project, work or lab);
- d) Try to obtain experience relevant to ambitions e.g. summer schools;
- e) Enter for e.g. essay prize provided annually by Centre for Bioscience.

NOTE: the main point to come out of this discussion was the paucity of possibilities available at a single university.

## **12.2 Scenario 2: Stretching the top 20% of bioscience students in an institution**

The Centre for Bioscience is offering £750,000 over 5 years to initiate a project which will provide stretch for exceptionally able bioscience students at a single university. The Centre is calling for outline funding applications to host and run this project. What features would be at the heart of your proposal and would provide the necessary stretch? There follows various options that arose from the discussion:

- a) Fund summer work placement/lab experience within university (including placement tutor);
- b) Academic scholarships;
- c) Extra tuition/seminars;
- d) Arrange inspirational lecture series by visiting speakers;
- e) Staff training (identifying higher flyers and provision of resources);
- f) Peer mentoring;
- g) Develop advanced skills centre with resources;
- h) Summer school on particular aspects of bioscience;
- i) Fund membership of learned societies;
- j) Provide industrial placements;
- k) Enter essay for undergraduate prize (e.g. Centre for Bioscience essay competition).

## **12.3 Scenario 3: Stretching the top 2% of bioscience students in the country**

The Centre for Bioscience is offering £750,000 over 5 years to initiate a project which will provide stretch for the top 2% of exceptionally able bioscience students within the country. The Centre is calling for outline funding applications to host and run this project. What features would be at the heart of your proposal and would provide the necessary stretch?

Create a National Institute of Excellence consisting of:

- a) Virtual Learning Environment (VLE) – students have access to this throughout their degree, with: access to other more able students; networking opportunities; competitions with prizes; mentoring by expert tutors;
- b) Easter and / or Summer schools, e.g. certificated 5 day summer school run in industry; courses at other universities;
- c) Bursary scheme for work experience (term time and/or holidays) so student needs to spend less time in paid work;
- d) Conference / On-line publications;
- e) Academic mentoring / employer mentoring on one-to-one basis.

Entry to the National Institute of Excellence, competitive at national level, would be based on past performance and performance in a set task. There would be a need to obtain feedback from those in year 1 of the National Institute of Excellence and to modify the centre in light of the feedback.

## 13. Conclusions

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In this forum the concept of differentiated learning has been taken to be characterised by:

*The intentional provision of different learning opportunities so as to stretch **ALL** students to their full potential.*

There is a perception that this stretching is not currently happening with the most able students and that it is an important area for development for the future health of the UK economy and the development of new scientific knowledge.

There are a large number of issues around this topic which need to be considered and resolved including:

- What is the nature of the provision which will appropriately stretch the most able?
- What aspect(s) of skills, knowledge and attitudes should be involved?
- What resources will be needed and where will it come from?
- How many students might be involved on a national basis or local basis?
- How are such students identified?
- How is provision organised and by what provider(s)?
- How are selection, assessment and accreditation carried out?

## 14. What actions should the Centre for Bioscience now take?

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A number of suggestions for practical actions were made:

- a) Provide information for existing and new HE teachers containing practical advice on how to support able students (e.g. top 2% and top 20%);
- b) Try to find simple exercises or tasks that can be integrated within a course but would provide stretch for able students;
- c) Canvas the bioscience community for ideas and opinions on differentiated learning, ask for input and reflection on the report from those not at the forum;
- d) Provide links to sources of summer studentships and funding for studentships / placements – e.g. Nuffield, BBSRC, Wellcome;
- e) Have an area of the website dedicated to excellence and make it open for discussion and contributions;
- f) Have a National Undergraduate Prize (for example, the British Neuroscience Association have one for undergraduates). This could be linked with / in conjunction with Bioscience Horizons ([www.oxfordjournals.org/our\\_journals/biohorizons/](http://www.oxfordjournals.org/our_journals/biohorizons/), publishing undergraduate research projects);
- g) Use the Centre's Departmental and Project Funding for innovation in teaching to encourage development of ways to stretch excellent students;
- h) Form a Special Interest Group / web based discussion group on developing excellence;
- i) Explore possibilities for interest in differentiated learning from Higher Education Academy, other Subject Centres (e.g. the STEM group) or the Biosciences Federation Education Committee?

NOTE: The Centre will have to consider the demand across the whole sector as well as relative priorities in deciding which, if any, of these suggestions to follow up.

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PowerPoint slides presented during the forum are available from:  
[www.bioscience.heacademy.ac.uk/events/dlforum07.aspx](http://www.bioscience.heacademy.ac.uk/events/dlforum07.aspx)

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